270080

FLOOD INSURANCE STUDY

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CITY OF DILWORTH, MINNESOTA

CLAY COUNTY

NOVEMBER 19, 1980

federal emergency management agency

federal insurance administration

COMMUNITY NUMBER - 270080

FEMA 29

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map

FLOOD INSURANCE STUDY

CITY OF DILWORTH,
CLAY COUNTY, MINNESOTA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Dilworth, Clay County, Minnesota, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert the City of Dilworth to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.1 (d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by McCombs-Knutson Associates, Inc., for the Federal Insurance Administration, under Contract No. H-4707. This study was completed in September 1979.

1.3 Coordination

Streams requiring detailed study were indentified at a meeting attended by representatives of the Study Contractor, the FIA, the Minnnesota Department of Natural Resources (DNR), and the county in March 1978. Other meetings with local residents and city officals were held in August 1978 to obtain information related to high water marks, past flood history, and city maps. Results of the hydrologic analysis were coordinated with the U.S. Army Corps of Engineers (COE), the DNR, the Soil Conservation Service (SCS), and the U.S. Geological Survey (USGS). A meeting was held in June 1979 between city officials, the DNR, and the Study Contractor to discuss the selection of floodways in the detailed study areas.

On March 19, 1980, the results of the work by the Study Contractor were reviewed and accepted at a final coordination meeting attended by representatives of the FIA, the Study Contractor, and the City of Dilworth

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of the City of Dilworth. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction through September 1984. The scope and methods of study were proposed to and agreed upon by the FIA and the City of Dilworth.

County Ditch 50, located in the northern part of the City of Dilworth, and County Ditch 41, located in the southern part of the City of Dilworth, were studied within the corporate limits by detailed methods.

2.2 Community Description

The City of Dilworth is located in the central-western part of Clay County, in western Minnesota. The city is 0.5 miles east of Moorhead, along U.S. Highway 10, and has a population of 2,321 as of July 1976 (Reference 1).

The Burlington Northern Railroad Company is the major industry in this city with one main station and numerous active railroad tracks. County Ditch 50 is actually separated from County Ditch 41 by these tracks.

The climate in this area is dry continental, with extreme seasonal variations in temperature from -50 degrees Fahrenheit (F.) in the winter to 115 degrees F. in the summer. The average annual temperature is about 41 degrees F. and the average annual precipitation is about 22 inches (References 2 and 3).

The topography of this area is extremely flat with little or no relief. The vegetation is mostly agricultural. Dilworth soils are of the Bearden Association, which is silty loam and silty clay and silty clay loam, and the Fargo Association, which is poorly drained consisting of silty clays and clays (Reference 4).

County Ditch 50, running east-west through the northern part of Dilworth, has a drainage area of 1.9 square miles and a length of study reach of 2.8 miles (Reference 5). County Ditch 41, also running east-west through the southern part of Dilworth, has a drainage area of 9.6 square miles and a detailed study reach of 2.5 miles (Reference 4).

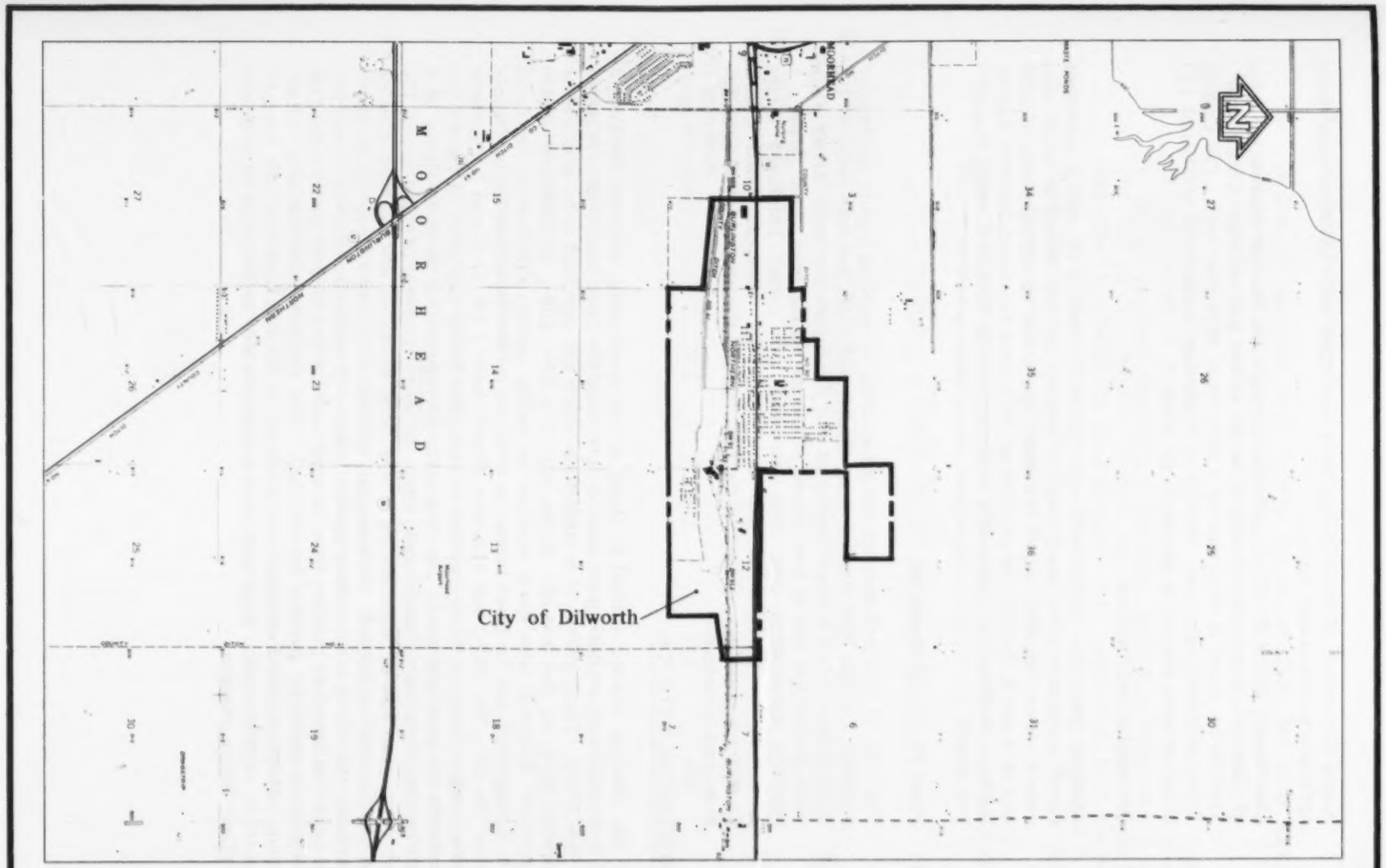

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF DILWORTH, MN
(CLAY CO.)

APPROXIMATE SCALE
4000 0 4000 8000 12,000 FEET

VICINITY MAP

About 50 percent of the city has been developed, with the remainder being agricultural and vacant lands.

The County Ditch 50 flood plain runs through the heavier residential areas of Dilworth, consisting of single family homes and a large trailer court. This trailer court is experiencing a very rapid expansion rate. The County Ditch 41 flood plain runs through a residential area. An additional 150 homes may be erected in the next few years.

2.3 Principal Flood Problems

Flooding problems in Dilworth are primarily caused by spring snowmelt runoff combined with heavy rains. Intense summer rainfalls could also create severe flooding. Local residents report that the spring floods of 1968 and 1979 and a flood in the summer of 1975 were the worst floods in recent history. Much of the community would experience shallow flooding in a 100-year event.

2.4 Flood Protection Measures

The City of Dilworth depends almost entirely on existing county ditches for drainage. An old dike located along County Ditch 50, just southwest of the intersection of 4th Avenue Northeast and 7th Street Northeast offers little flood protection and is overtopped in places during peak flood flows. A recently constructed dike that parrallels 7th Street Southeast offers protection to portions of the city from the 100-year flood event. Emergency measures utilized in the past include the placement of sandbags in several locations.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten), and for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

The discharge-frequency data for the two county ditches were developed through the use of the SCS TR-20 Computer Program and methods described in the SCS National Engineering Handbook, Section 4 (References 6 and 7). The SCS TR-20 Computer Program uses the physical characteristics of the watershed to predict the flood discharge that would occur from the rainfall event of a selected frequency of occurence. Runoff depth for a given rainfall depth was determined based on soil type, land use, land treatment, and general hydrologic conditions in the watershed.

Peak discharges for the 10-, 50-, 100-, and 500-year floods of each flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
COUNTY DITCH 41					
At downstream corporate limit	9.6	435	625	735	970
At upstream corporate limit	7.9	251	350	405	520
COUNTY DITCH 50					
At downstream corporate limit	1.9	120	170	210	290
At upstream corporate limit	0.8	15	20	25	35

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Cross sections for the backwater analyses of County Ditch 50 and County Ditch 41 in Dilworth were selected at close intervals upstream and downstream of bridges, culverts, and other obstructions to compute significant backwater effects of these structures. Additional cross sections were located to reflect significant variations in stream valley topography. Data for these cross sections were obtained by field surveys.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Channel and overbank roughness factors (Manning's "n") used in the hydraulic computations were chosen based on engineering judgment and on a combination of field observations of the flood plain area and aerial photographs of each studied stream (Reference 8). Roughness factors for the channel of County Ditch 50 range from 0.030 to 0.040, with overbank roughness factors ranging from 0.035 to 0.150. Roughness factors for the channel of County Ditch 41 range from 0.032 to 0.042, with overbank roughness factors ranging from 0.038 to 0.120.

Starting water-surface elevations for these two county ditches were calculated using the slope-area method.

Water-surface elevations of floods of the selected recurrence intervals were computed through the use of the COE HEC-2 step-backwater computer program (Reference 9). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence inervals (Exhibit 1).

Due to the extremely flat topography of the area and the perched channel banks of the county ditches, much of the community is subject to shallow flooding averaging from less than one to two feet in depth. The overflow from the county ditches leaves the channel and flows away from the ditch because the channel banks are higher than the surrounding area. Depths were determined using available topographic information and data generated by the detailed analysis of the county ditches (Reference 4). Flood elevations for these two county ditches can be raised by debris accumulations and ice jams at hydraulic structures.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles are, therefore, considered valid only if hydraulic structures, in general, remain unobstructed and if channel and overbank conditions remain essentially the same as ascertained during this study.

All elevations are referenced from National Geodetic Vertical Datum of 1929 (NGVD); elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year floods have been delineated using the elevations determined at each cross section; between cross sections the boundaries were interpolated using topographic maps at a scale of 1:24000 with a contour interval of five feet and additional data from field inspection (Reference 4). The boundaries of areas affected by shallow flooding were also determined by field inspection and the above-mentioned topographic maps. .

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to lack of detailed topographical information or to limitations of the map scale, such areas are not shown. In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. In Minnesota, however, flood plain encroachment is limited by Minnesota Regulations to that which would cause a 0.5-foot increase in flood heights above prefloodway conditions at any point (Reference 10). Floodways having no more than a 0.5-foot surcharge were delineated for this study.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 2).

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
COUNTY DITCH 41							
A	250	65	297	2.5	907.0	907.0	0.0
B	2850	70	333	2.0	908.0	908.0	0.0
C	4175	50	305	2.2	908.3	908.1	0.2
D	5690	55	310	1.9	908.8	908.5	0.3
E	6380	57	330	1.6	909.0	908.7	0.3
F	7040	57	338	1.6	909.1	908.9	0.2
G	8080	55	215	2.2	909.8	909.5	0.3
H	8380	55	222	2.1	909.9	909.7	0.2
I	9640	50	197	2.0	910.4	910.2	0.2
J	10,260	77	342	1.2	910.5	910.4	0.1
K	11,102	83	173	2.4	910.7	910.6	0.1
L	11,702	83	168	2.4	911.0	910.9	0.1
COUNTY DITCH 50							
A	2780[2]	82/40[3]	183	1.2	905.2	905.2	0.0
B	4180[2]	58	157	1.0	905.4	905.3	0.1
C	5480[2]	50	142	1.1	905.5	905.5	0.0
D	5710[2]	59	205	0.5	906.5	906.4	0.1
E	6130[2]	60	182	0.6	906.5	906.4	0.1
F	6465[2]	57	210	0.3	907.2	907.2	0.0
G	6795[2]	54	200	0.2	907.3	907.2	0.1
H	7135[2]	61	193	0.1	907.3	907.2	0.1
I	8240[2]	41/20[3]	120	0.3	907.6	907.4	0.2
J	9070[2]	35/20[3]	97	0.4	907.6	907.4	0.2
K	9340[2]	67	195	0.3	908.5	908.4	0.1
L	9638[2]	70	273	0.2	909.6	909.4	0.2
M	10,918[2]	280	593	0.1	911.1	910.7	0.4
N	11,852[2]	73	204	0.2	911.1	910.7	0.4
O	12,604[2]	77	344	0.1	912.4	912.3	0.1

[1]FEET ABOVE CORPORATE LIMITS
[2]FEET ABOVE LIMIT OF DETAILED STUDY 2680 FEET DOWNSTREAM FROM COUNTY ROAD 9
[3]TOTAL WIDTH / WIDTH WITHIN CORPORATE LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF DILWORTH, MN
(CLAY CO.)

FLOODWAY DATA

COUNTY DITCH 41 - COUNTY DITCH 50

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 0.5 at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

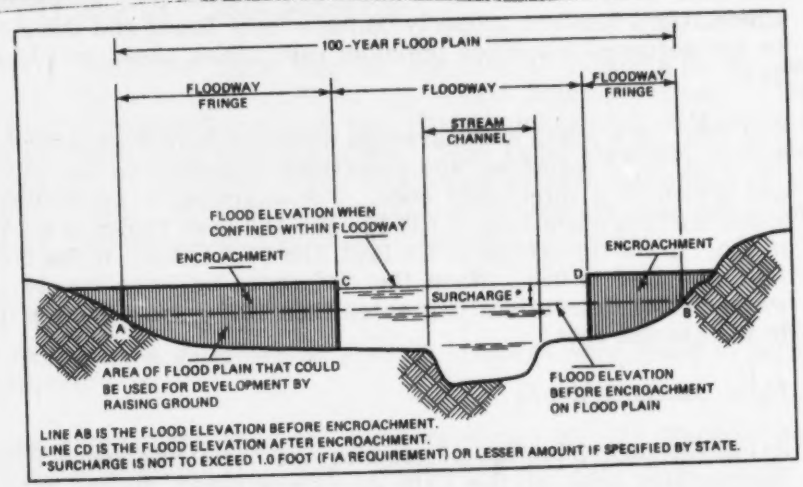
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FIGURE 2 - Floodway Schematic

The floodways in this report are recommended to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHF), and flood insurance zone designations for each flooding source affecting the City of Dilworth.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the City of Dilworth are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 3).

5.2 Flood Hazard Factors

The FHF is used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the City of Dilworth was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone AH: Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; base flood elevations are shown, but no FHFs are determined.

Zones A1-A3: Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations are shown, and zones subdivided according to FHF.

Zone B: Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water

control structure; or areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Dilworth is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

No other studies for the incorporated area of Dilworth were found to exist at the time of this report.

A Flood Hazard Boundary Map has been published by the Federal Insurance Administration (Reference 11). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the National Flood Insurance Program.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic and other pertinent data used in this study can be obtained by contacting the Insurance and Mitigation Division, Federal Emergency Management Agency, One North Dearborn Street, Chicago, Illinois 60602.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
COUNTY DITCH 41							
REACH 1	0001	–1.6	–0.5	0.3	015	A3	VARIES–SEE MAP
COUNTY DITCH 50							
REACH 1	0001	–1.0	–0.3	1.1	010	A2	VARIES–SEE MAP
REACH 2	0001	–0.2	–0.1	0.1	005	A1	VARIES–SEE MAP

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
CITY OF DILWORTH, MN
(CLAY CO.)

FLOOD INSURANCE ZONE DATA

COUNTY DITCH 41 - COUNTY DITCH 50

8.0

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2. U.S. Geological Survey, Water Resources Investigation 78-132 Open File Report, Stephanie A. Warne, 1978.

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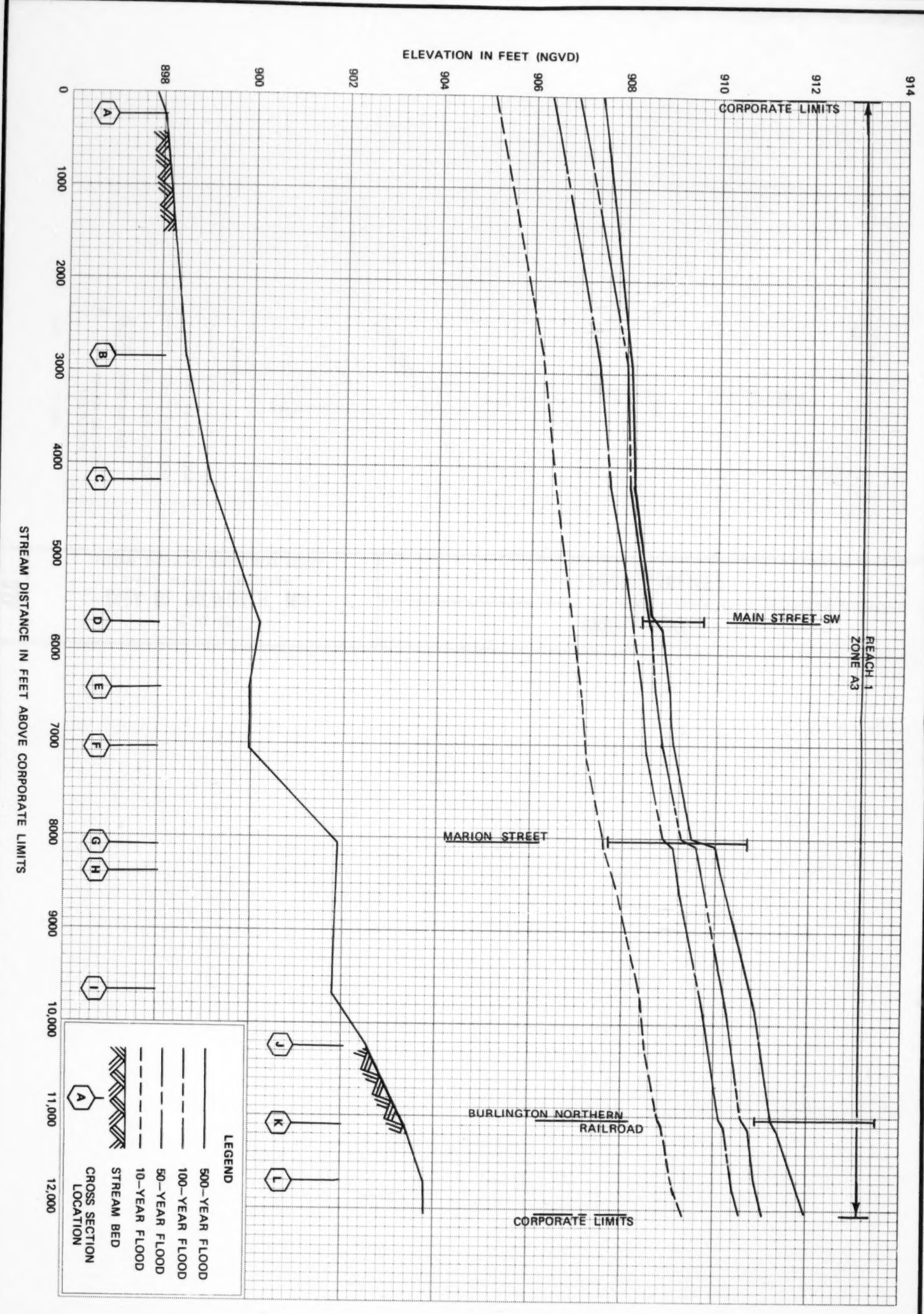
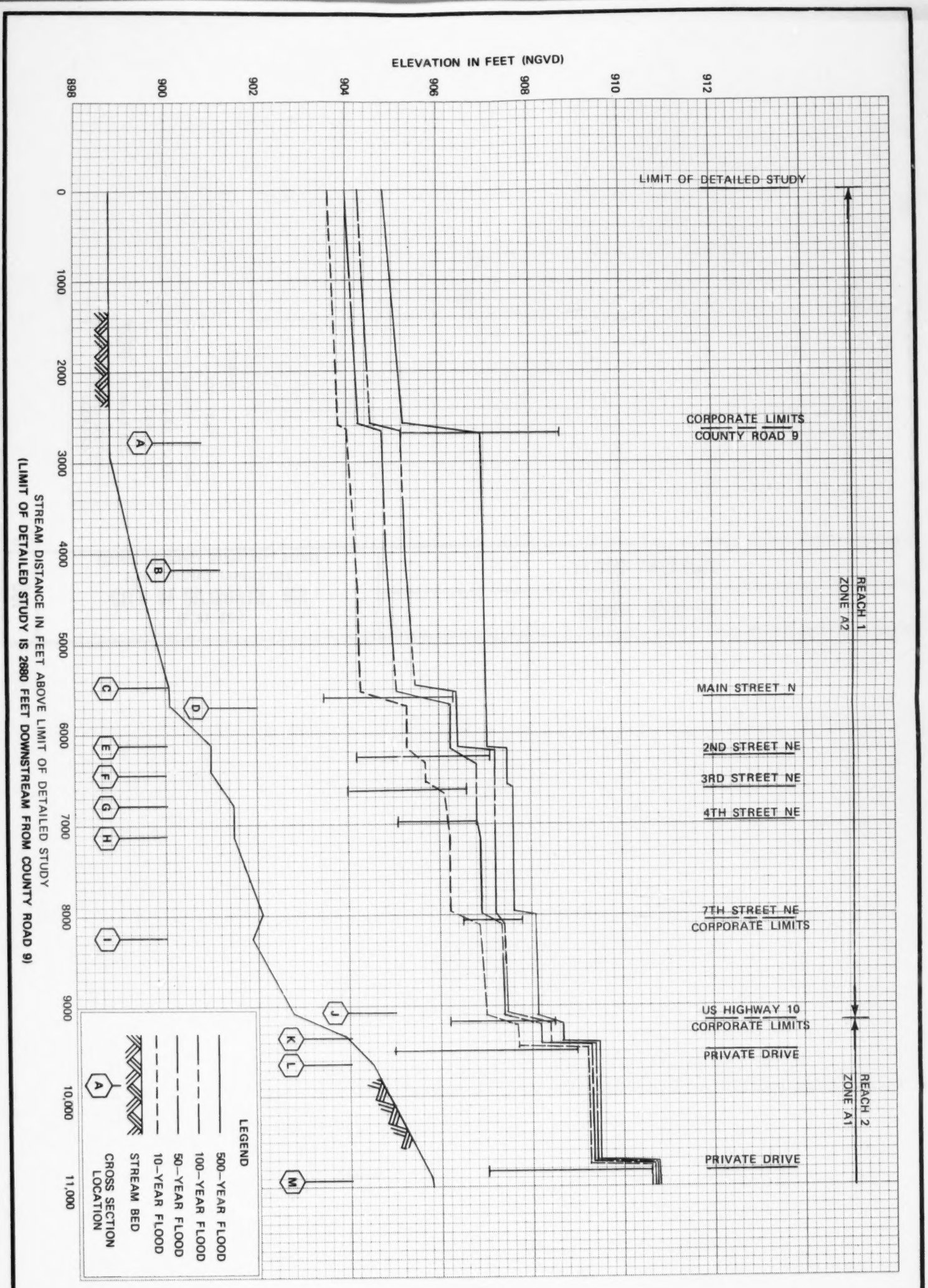


01P

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
CITY OF DILWORTH, MN
(CLAY CO.)

FLOOD PROFILES

COUNTY DITCH 41



02P

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
CITY OF DILWORTH, MN
(CLAY CO.)

FLOOD PROFILES

COUNTY DITCH 50

REACH 2
ZONE A1

PRIVATE DRIVE

PRIVATE DRIVE

CORPORATE LIMITS

914

912

910

908

906

904

ELEVATION IN FEET (NGVD)

N

O

11,000 12,000 13,000 14,000 15,000

STREAM DISTANCE IN FEET ABOVE LIMIT OF DETAILED STUDY
(LIMIT OF DETAILED STUDY IS 2680 FEET DOWNSTREAM FROM COUNTY ROAD 9)

LEGEND

- 500–YEAR FLOOD
- 100–YEAR FLOOD
- 50–YEAR FLOOD
- 10–YEAR FLOOD
- STREAM BED
- A — CROSS SECTION LOCATION

FLOOD PROFILES

COUNTY DITCH 50

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF DILWORTH, MN
(CLAY CO.)

03P